



FOUNDATION CHEMISTRY  
Mark Scheme 2811  
June 2003

1. (a) (i) P ✓

[1]

(ii)  $1s^2 2s^2 2p^6 3s^2 3p^3$  ✓

[1]

(iii) charge on ion:  $3-$  ✓

[1]

electronic configuration of ion of A:  $1s^2 2s^2 2p^6 3s^2 3p^6$  ✓

[1]

(b) (i) different number of neutrons ✓

[1]

(ii) Ni ✓

[1]

(c) (i) average atomic mass/weighted mean/average mass ✓

compared with carbon-12 ✓

1/12th of mass of carbon-12/on a scale where carbon-12 is 12 ✓

OR

The mass of 1 mole of atoms of an element ✓

compared with 12 g ✓

of carbon-12 ✓

[3]

(ii)  $58.0 \times 68.2/100 + 60.0 \times 27.3/100 + 62.0 \times 4.5/100 = 58.726$  ✓

$= 58.7$  ✓ (to 3 sig figs: allow full marks for answer. 58.726 (calc) gets 1 mark only)

[2]

[Total: 11 marks]

2. (a) correct dot and cross ✓

[1]

(b) number of electrons increases down group ✓

→ greater van der Waals' forces/intermolecular forces ✓

more energy/higher temperature needed to break these intermolecular forces ✓

[3]

(c) (i) brown/orange/yellow colour ✓

[1]

(ii)  $2\text{NaBr} + \text{Cl}_2 \longrightarrow \text{Br}_2 + 2\text{NaCl}$  balanced equation ✓

or ionic equation:  $2\text{Br}^- + \text{Cl}_2 \longrightarrow \text{Br}_2 + 2\text{Cl}^-$

[1]

(iii)  $\text{Cl}/\text{Cl}_2$  gains electron(s) ✓  $\text{Br}^-$  loses an electron ✓

[2]

(iv) Cl is more reactive/more powerful oxidising agent than Br ✓

[1]

(v) add  $\text{AgNO}_3 / \text{Ag}^+$  ✓

yellow precipitate ✓

OR

add  $\text{Cl}_2 / \text{Br}_2$  ✓

purple in hexane / blue-black in starch ✓

[2]

[Total: 11 marks]

3. (a) correct dot and cross ✓ correct charges ✓ [2]
- (b) (i) Ca: (+)2 ✓ [1]
- (ii) C: (+)4 ✓ [1]
- (c) moles  $\text{CaCO}_3 = 20 \times 10^6 / 100 = 200\,000 \text{ mol}$  ✓  
 mass  $\text{CaO} = 200\,000 \times 56 = 11\,200\,000 \text{ g} / 1.12 \times 10^7 \text{ g} / 11.2 \text{ tonnes}$  ✓  
*use of  $56 \times 20/100$  OR  $56/5$  is worth 1 mark*  
*decimal point in wrong place i.e.  $1.12 \times 10^x$  is worth 1 mark.*  
*units needed for 2nd mark.* [2]
- (d)  $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2$  ✓ [1]
- (e) (i) molar mass =  $40.1 + (16 + 1) \times 2 = 74.1 \text{ (g mol}^{-1}\text{)}$  ✓ [1]
- (ii) moles  $\text{HCl} = 0.200 \times 25.0 / 1000 = 0.005 \text{ mol}$  ✓ [1]
- (iii) moles  $\text{Ca(OH)}_2 = 0.5 \times 0.005 = 0.0025 \text{ mol}$  ✓  
 mass  $\text{Ca(OH)}_2 = 0.0025 \times 74.1 = 0.185 \text{ g}$  ✓ accept from 0.19 g to 0.18525 g  
*i.e.  $0.0025 \times$  answer to (i)*  
 candidate who does not use 0.5 will get 0.37 g – worth 1 mark [2]
- (iv) 1 mol  $\text{NaOH}$  reacts with 1 mol  $\text{HCl}$   
 /  $\text{Ca(OH)}_2$  Has more OHs / OHs needed to neutralise ✓  
 Therefore twice the number of moles of  $\text{NaOH}$  are needed  
 / twice number of OHs in  $\text{Ca(OH)}_2$  ✓ [2]
- (f) solution reacted with  $\text{CO}_2$  ✓ forming  $\text{CaCO}_3$  ✓ [2]

[Total: 15 marks]

4. (a) 4 valid examples ✓✓✓✓

*Can be names or formulae. If a formula is used, it must be correct for the structure: i.e. for simple molecular,  $H_2$ ,  $P_4$ ,  $S_8$ , etc is required.*

[4]

(b) (i) positive ions/metal ions/cations ✓

surrounded by free/delocalised/sea of electrons ✓

[2]

(ii) electrons move ✓

[1]

(c) solid lattice, ions are in fixed positions ✓

molten, ions are free to move and conduct ✓

[2]

(d) giant has stronger forces/simple has weaker forces ✓ (*i.e. comparison of forces*)

giant: covalent bonds break ✓

simple: molecules/intermolecular forces break / van der Waals break ✓

[3]

[Total: 12 marks]

5. electron pairs repel ✓  
as far apart as possible ✓  
lone pair repulsion > bonded pair repulsion / lone pair reduces bond angle ✓

[3]

4 examples, for each: shape ✓✓✓✓

*either*

a named molecule that matches a correct shape

*or*

correct number and type of electron pairs to match shape

3 correct bond angles ✓✓✓

[7]

[Sub-total: 10]

qowc: technical words of three shapes:

i.e. linear

non-linear / V-shaped / angular / bent

trigonal planar / planar triangle

tetrahedral / tetrahedron

pyramid(al) / trigonal pyramid(al)

[Sub-total: 1]

[Total: 11 marks]

## Further notes on Question 5

## 1. Three marks that explain the theory:

electron pairs repel ✓

• This could simply be within 'electron pair repulsion theory' or 'lone pairs repel'

lone pairs repel more ✓

repelled as far apart as possible ✓

## 2. Seven marks for shapes and bond angles

## Bond angles

• Credit up to three correct bond angles for chosen examples. i.e. 3 max

## Shapes

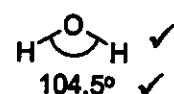
(a) If a candidate has drawn shapes of molecules,

• mark the shapes irrespective of any words that describe them.

• only look at the words (pyramidal, etc) for the QoWC mark (see below)

• do not use an incorrect name as a 'con' or we will be looking for both the shape and the name for the mark.

e.g.

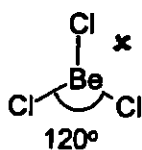


trigonal planar ✓

ignore except for QoWC

(b) If a candidate has drawn a 'correct' shape for a molecule that does not exist, then the shape mark cannot be awarded. e.g.  $\text{BeCl}_3$  shown as a trigonal planar molecule would not score the shape (but could score an angle mark of  $120^\circ$  if 'trigonal planar' is used as a fall back). The example below is certainly worth something!

e.g.



trigonal planar ✓

This rescues the angle mark

(c) If a candidate has not drawn a diagram,

• the shape mark is still possible if the correct technical word is used. If this tactic has been used then you can still award the technical words as part of the QoWC mark (see below).

e.g.  $\text{CH}_4$  has a tetrahedral shape ✓ with a bond angle of  $109.5^\circ$  ✓

## QoWC One mark

Use of any three of the 'shape technical words' with correct shapes.

i.e. testing 'correct usage' of technical words.

The following annotations may be used when marking:

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
<u>      </u> (underlining)	=	key words which <u>must</u> be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument